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**Imajo**

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(54) **WAVELENGTH DIVISION MULTIPLEX  
OPTICAL STAR COUPLER,  
COMMUNICATION STATION, AND  
OPTICAL TRANSMISSION SYSTEM**

4,723,309 A \* 2/1988 Mochizuki et al. .... 359/119  
4,801,190 A \* 1/1989 Imoto ..... 385/24  
4,850,047 A \* 7/1989 Iguchi et al. .... 359/117  
5,189,414 A \* 2/1993 Tawara ..... 340/825.5

**FOREIGN PATENT DOCUMENTS**

EP 0641094 A1 \* 7/1994

\* cited by examiner

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(58) **Field of Search** ..... 359/110-119, 128,  
359/134, 139, 341; 340/825.02, 825.5;  
385/24, 46

(56) **References Cited**

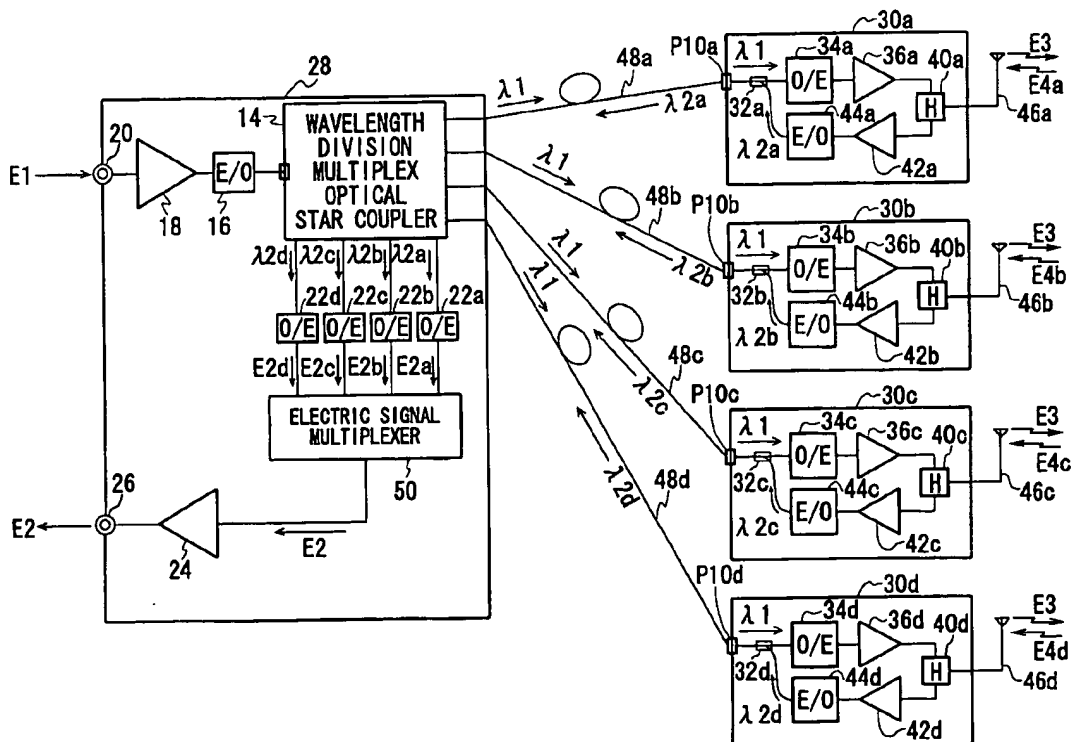
**U.S. PATENT DOCUMENTS**

4,581,770 A \* 4/1986 Haworth ..... 359/119

(57) **ABSTRACT**

A wavelength division multiplex optical star coupler comprises an input port which inputs a first optical signal, a first optical coupler which divides the first optical signal input from the input port into a plurality of first optical signals, a plurality of input/output ports, each of which outputs one of the plurality of first optical signals divided by the first optical coupler and inputs a second optical signal, an output port which outputs the second optical signal, and a second optical coupler, provided between the input port and the first optical coupler or between the first optical coupler and the input/output ports, which provides the first optical signal to the input/output ports and the second optical signal to the output port.

**6 Claims, 5 Drawing Sheets**



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the substrate. The wavelength division multiplex optical star coupler 14 and 15 can be easily manufactured by using a conventional optical fiber fusion optical coupler or a conventional waveguide optical coupler for the optical star coupler 12 and the wavelength division multiplex optical 5 coupler 10.

Although the present invention has been described by reference to specific embodiments, the scope of the present invention is not limited to these embodiments. Those skilled in the art can make various modifications and improvements 10 to these embodiments of the present invention. It is clear from the appended claims that such modifications or improvements are also covered by the scope of the present invention.

What is claimed is:

1. A communication station comprising:

an electro-optical converter which inputs an electric signal and converts said electric signal to a first optical signal;

a first optical star coupler which divides said first optical signal into a plurality of first optical signals;

a plurality of input/output ports, each of which outputs one of said plurality of first optical signals divided by said first optical coupler and inputs a second optical 25 signal;

an output port which outputs said second optical signal;

a second, wavelength division multiplex optical coupler, provided between said plurality of input/output ports and said output port, said second optical coupler connecting to said first optical coupler and providing said 30 first optical signal to said input/output ports and said second optical signal to said output port;

an opto-electric converter which converts said second optical signal output from said output port to a second 35 electric signal; and

an electric signal output terminal which outputs said second electric signal.

2. A communication station as claimed in claim 1 having: 40 a plurality of said output ports,

a plurality of said second optical couplers, each of which is provided between said first optical coupler and one of said input/output ports,

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a plurality of said opto-electric converters, each of which is provided for one of a plurality of said output ports, and

an electric signal multiplexer which multiplexes a plurality of said second electric signals output from a plurality of said opto-electric converters and outputs said multiplexed second electric signal to said electric signal output terminal, wherein:

each of said second optical couplers provides one of said second optical signals to one of said plurality of output ports;

each of said plurality of output ports outputs one of said second optical signals; and

each of said plurality of opto-electric converters converts one of said second optical signals to said second electric signal.

3. A communication station as claimed in claim 1, wherein said second optical coupler is provided between said electro-optical converter and said first optical coupler;

said first optical coupler further multiplexes a plurality of said second optical signals and provides said second optical signal to said second optical coupler; and

said second optical coupler provides said first optical signal input from said electro-optical converter to said first optical coupler and provides said second optical signal multiplexed by said first optical coupler to said output port.

4. A communication station as claimed in any of claims 1 through 3, wherein said second optical coupler is a wavelength division multiplex optical coupler that selects an optical signal, which has a wavelength having a prescribed relationship with wavelength of said second optical signal, from optical signals input to said second optical coupler and outputs said selected optical signal to said output port.

5. A communication station as claimed in any of claims 1 through 3, wherein each of said input/output port and said output port has an optical connector adapter that detachably mounts an optical fiber.

6. A communication station as claimed in claim 4, wherein each of said input/output port and said output port has an optical connector adapter that detachably mounts an optical fiber.

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